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ACTIVITIES (D5)

For a successful space program: Quality and Safety! (1)

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Carnegie Mellon University, United StatesOPERATIONAL RISK MANAGEMENT IN STUDENT SPACE MISSIONS THROUGH
FMEA-CENTRIC SOFTWARE**Abstract**

Within student-led space operations, operational risks inherent to the natural turnover of academic programs compound the risks of potential design failures due to student inexperience. Therefore, integrating a continuous Failure Modes and Effects Analysis (FMEA) or similar process is an essential component of a student space systems design process. Over a multi-year project, an interdisciplinary team of Carnegie Mellon University (CMU) students developed the Iris Lunar Rover to be remotely operated on the lunar surface by student operators from a student-built mission control center, Carnegie Mellon Mission Control (CMMC). Iris and CMMC saw multiple systems and software redesigns as students rotated with fresh ideas. When it came time for the mission, most of the contributing members from years past had moved on from the program. To manage operational risks, a data pipeline and front end were developed to provide student operators with real-time telemetry, fault analysis, and failure mode recommendations leveraging an FMEA database. This pipeline provides CMMC with a platform for continuous evaluation of potential failures, enhances mission readiness through mission simulations, and bridges the systems knowledge gap between student engineers and operators.

This paper proposes an FMEA-centric software pipeline that can be leveraged to meet the unique operational challenges of university space programs (e.g. CubeSats and future planetary rovers), encompassing the continuous evaluation of potential system design failures, the value of an FMEA backend in space mission simulations, and the transfer of system knowledge to an interdisciplinary mission operations team. This paper also addresses the design process and challenges in creating a pipeline that is flexible, extensible, and balances automation with manual operation.